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# INTERNATIONAL SPACE STATION TRAILER

## VOLUNTEER INFORMATION GUIDE

### Introduction

The International Space Station is the beginning of a permanent human presence in space – with the first crew to reside on the station, humans will be living in space not only the next decade, but also the next century and the next millennium. The permanent human presence will not always be on the International Space Station, but will move on to other spacecraft and other celestial bodies such as the Moon and Mars.

### International Space Station A-Z Quick Looks

**Altitude** – 250 statute miles

**Assembly Flights** – More than 40 U. S., more than 75 total

**Assembly Years** – More than 6

**Atmosphere** – 14.7 pounds per square inch

**Crew** – Three during early assembly, Up to seven later

**Expedition Crew Members** – Name given to crews on the station

**Station Lifetime** – 15-20 years

**Inclination** – 51.6 degrees

**Mission Control Centers** – Houston and Moscow

**Orbits Completed** – More than 7, 000 orbits, an orbit every 90 minutes

**Protective Outer Wall** – 1/40<sup>th</sup> thickness of station's diameter (Earth's protective atmosphere 1/160<sup>th</sup> of the Earth's diameter)

**Power** – 110 kilowatts, will run on 120-volt direct-current power

**Solar Arrays** – Deep as an end zone of a football field and twice as wide

**Station Sightings, viewing and Current Facts** –

<http://spaceflight.nasa.gov/station/index.html>

**Station Visibility** – Visible to the naked eye as a moving “star” in the night sky

**Volume** – At completion/43,000 cubic feet, approximate interior volume of a 747 jumbo jet

**Water Supplies** – Water will be recycled onboard and new supplies delivered by shuttle and Progress capsule flights.

**Weight** – At completion/1 million pounds on Earth

**Width/Length** – At completion/356 feet by 290 feet, larger in area than a football field

## **Frequently Asked International Space Station Questions**

1. How long will each ISS Expedition crew stay in space? 3 -4 months
2. How does the space station get resupplies of food and water? Resupplies come from both Russian Progress capsule and U. S. shuttle flights.
3. How often? Every flight will carry some kind of supplies such as fresh fruit and vegetables.
4. How high is the Space Station? Circling at 250 statute miles.
5. What is the danger of the station being hit by space debris? The station can withstand small impacts and can avoid larger objects, which are tracked. There are some medium sized objects which could do some damage, but the odds are small that this will happen.
6. What damage could it do to the station? In the unlikely event of an impact, objects could puncture a module or damage other external structures. If this situation became a risk to safety, the crew will use an emergency escape vehicle, which will always be available when a crew is in residence.
7. How long can the space station last? 15-20 years
8. What happens to the human body in microgravity? This is actually part of the research to be done on the space station. We already know that the human body “stretches” about two inches. There is also some loss of bone mass and red blood cells. Some changes are temporary and some are permanent.
9. What if someone gets seriously ill or injured on the space station?  
Crew members are medically trained for all possible emergencies. In the event of a life-threatening problem, the crew can return to Earth in a Russian Soyuz capsule, or later in the X-38 “lifeboat.”
10. With so many countries involved, which country is in charge on the station? The U.S. has the lead for all ISS operational decisions.
12. Will crew members be able to phone home? No, but they will be able to stay in touch by E-mail and times are set aside regularly for private family conferences.

## **Overview of Tour Trailers**

Visitors are not seeing exact replicas of what the station modules will look like, but rather examples of features of the Habitation and Laboratory Modules.

### **Habitation Module**

*Descriptions of racks are right to left, as you are facing them:*

Rack 1 – Storage

Rack 2 – Storage

Rack 3 – “Refrigerator” is not intended to be a refrigerator, but shows visitors the variety of food items crew members will have available to eat.

Rack 4/6 – Sleep area includes Dr. Emily Richards, an animatronic figure that interacts with the on-camera personality discussing life on ISS; video presentation

Rack 5 – Food preparation area, 3-D replica of oven, etc.

Rack 7 – Shower, washroom area

Rack 8 – Storage; video presentation

Rack 9 – Toilet

Rack 10 – Storage

Rack 11 – Storage/Utility Rack

Rack 12 – Communications Center Rack including laptop computers

### **Connecting Module**

Looking left, above and straight-ahead, transparencies showing astronauts in modules.

Looking below feet is a “storage” area with crew items, i.e. gloves, garments, etc.

To the right is a “moving” centrifuge

### **Laboratory Module**

Rack 1 – Crystal growth chambers

Rack 2 – Display representing the important role plants play in research for long-duration missions

Rack 3 – Utility Rack

Rack 4 – Bio Support rack and interactive glove box allowing visitors to touch and learn by experience with video presentation

Rack 5 – Earth view interactive display where visitors can see selected views taken of various places on the Earth

Rack 6 – Human bio-medical

Rack 7 – Furnace

Rack 8 – Animal Research enclosures; video presentation

Rack 9 – Crystal growth experiment

Rack 10 – Cell and tissue culture; video monitor in the floor with presentation

Rack 11 – Docking equipment with “joy stick” and video presentation

Rack 12 – Utility rack

### **Exit/Docking Tunnel**

Photographic images on either side of this area represent the station during assembly.

One photograph shows an orbiter docked to the station. Yet another shows astronauts working during a station Extra Vehicular Activity (EVA).

### **Exit**

Handout literature available to visitors

## **Participating Countries/Launch Vehicles/Locations**

- **International Partners:** The United States, Russia, Canada, Belgium, Denmark, France, Germany, Italy, the Netherlands, Norway, Spain, Sweden, Switzerland, the United Kingdom, Japan, and Brazil.
- **International Partners' Launch Vehicles/Locations:**
  - U.S. - Space Shuttles - Kennedy Space Center in Florida
  - Japanese - HII Rockets (Possible) - the Tanegashima Space Center in Kyushu, Japan
  - European Ariane 5 Rockets (Possible) - the Centre Spatiales in French Guiana
  - Russian - Proton and Soyuz vehicles - Baikonur Cosmodrome in Kazakhstan, Russia

## **Current Modules**

### **Zarya**

- Russian Zarya spacecraft, the name meaning “sunrise or dawn” was launched November 1998.
- Built in Moscow at the Khrunichev Space and Research Center and launched by the Russian Space Agency with U.S. funding.
- The 22-ton space tugboat, derived from 1970s Salyut space station design, provides initial electric power and control.

### **Unity**

- U.S. Unity node was launched during the STS-88 mission of Endeavour in December 1998.
- The Unity Module is a pressurized module that will be used to connect future U.S. modules to the station.
- The Unity has six attachment ports to allow connections to other modules.

## **Future Elements**

### **The Russian Zvezda Service Module**

The module is a completely self-contained space station and includes items such as food lockers, food heating area, a shower and toilet, making it essential for the early crews.

### **The Laboratories**

The U.S., European Space Agency (ESA), and Japanese labs will share equipment, electricity, and each other's facilities.

- 24 standard racks the size of clothes closets to house equipment and experiments
- Racks require identical wiring and plumbing
- Racks are weightless, moved by “unplugging” one rack and “plugging in” a new one
- Racks will house medical, biological, and materials experiments
- Data easily sent to hundreds of scientists on Earth
- Japan's module is called Kibo meaning “hope”

- Kibo has a back porch equipped with a robotic arm to move things outside

### **Habitation Module**

- The Habitation module is the permanent living quarters and will be delivered last.
- The Habitation Module is the life support center of the space station where the crews relax, sleep, and exercise.
- The wardroom is an area dedicated to food preparation, eating, and recreation.

### **The Canadian Robotic Manipulator Arm**

- The 57-foot-long jointed robotic arm can move 120 tons and is a larger, improved version of the Canadian arm used aboard shuttles.
- Robotic arm will be used for station assembly, maintenance, and moving supplies.
- Operated from inside the station, the arm will travel the 356-foot length of the station trusses aboard a trolley.
- The arm will reach the station's modules by detaching from the trolley and latching onto grapple fixtures. The extended end grabs a fixture and its base becomes the new working end.
- Attached to the end of the arm, the hands can remove covers, change batteries, and wield tools.

### **Solar Arrays**

- Huge photovoltaic panels will convert the sun's energy into electric power. The station will run on 120-volt direct-current power.
- Solar cells are part of freestanding wings or arrays, which are the white elements on either side of the center of the space station.
- They can be carried up in the space shuttle cargo bay and folded out in a blanket-like arrangement of huge arrays.
- Solar Arrays will be as deep as an end zone of a football field and twice as wide.

### **The Centrifuge Accommodation Module**

- Centrifugal force will be used to simulate gravity ranging from almost zero to twice that of Earth.
- This facility will imitate Earth's gravity for comparison purposes while eliminating variables in experiments and simulate the gravity on the Moon or Mars for experiments that can provide information useful for future space travels.

# **Life on the Space Station**

## **Health**

- The human body tends to lose muscle and bone mass rapidly in space.
- To fight this loss, at least two hours of strenuous exercise is built into every crew member's daily schedule.
- Humans require less sleep in space because our bodies do very little work in a microgravity environment.
- It takes little effort to raise an arm, hold your head up, or move a bulky object.
- Crew members will have private e-mails and conversations with family members.

## **Food/Water**

- Food aboard the station will be prepackaged and most of it is cohesive so it stays on spoons.
- Advances in food preparation and storage provide a variety of good food choices.
- Most of the food planned for space station will be frozen, refrigerated or thermostabilized and will not require the addition of water before consumption.
- Many beverages will be in a dehydrated form.
- Food will be heated to serving temperature in a microwave/forced air convection oven.
- One oven will be supplied for each group of four crew members.
- The food system consists of three different supplies of food that includes a Daily Menu, pantry, and Extra Vehicular Activity (EVA) food.
- Live plants will generate oxygen and take in carbon dioxide as well as being a food source.
- Crews use fewer than eight gallons of water a day per person (On Earth, the average is 160 gallons a day).
- Almost every drop of water is recycled on the station.

## **Personal Hygiene**

- Water floats in space and can be smeared on the body in the shower where an induced airflow helps collect and carry excess water away for recycling.
- The space station toilet operates much like the shuttle toilet. A subtle vacuum draws waste matter away from the body.

## **Clothing**

- The station will be a shirtsleeve pressurized environment. Crew members will need to wear clothes that are usually worn to work or to relax in.
- Outside the station the crews will wear the pressurized space suits.
- Soiled clothes will be brought back to Earth and fresh ones will be provided by visiting shuttle flights

## **Work Schedules/Crew Rotations**

- The first crew (1 American, 2 Russians) will occupy the service module in 2001. A normal crew will be six.
- Crews will be exchanged every three-four months.
- Crews will spend more time working on experiments than anything else after station assembly is complete.
- Some projects require teamwork so crew members will frequently work in pairs.

## **Station Logistics**

- The station has no up or down, so there are no real ceilings or floors. Instead, the labs and living quarters have four “walls” filled with equipment. Between the walls are triangular areas that contain wiring, plumbing, and ventilation systems.
- Modules will be colored with differing paint and labeled in both the Russian and English.
- The areas where the astronauts actually live and work are relatively small, about the size of the interior of a typical school bus.

## **Extra Vehicular Activities (EVA) or “space walks”**

- EVAs will take place to do routine maintenance as well as other activities.
- EVA food and drink, consisting of 500 calories of food and 38 oz. of water will be provided inside each crew member’s space suit.
- Crew members are expected to space walk for 850 hours to build the station, more than in all previous space flights combined.

## **Station Maintenance/Tools**

- Tools are similar to those used by amateur handymen, but modified to work in extreme cold, microgravity, and with bulky gloves.
- Tools include adjustable wrenches, off-the-shelf items with enlarged grips and tether loops made of beryllium copper alloy that will not break in intense cold.
- Hand-operated 3/8-inch drive socket wrenches with the sockets are tethered so they won’t float away.
- Crowbars made of beryllium copper alloy, for emergency use only
- Gripping pliers made of stainless steel like the ones used on Earth for surgery
- Custom cordless tools that are programmable so crews can set the number of turns and amount of torque.

## **Special Adaptations**

- Moveable foot restraints and handholds are used throughout the station to keep the astronauts in place as they work.
- Velcro is widely used to keep tools and personal items from floating away.
- Crews sleep standing up by “camping-out” wherever they feel comfortable by attaching their sleeping bags to the wall with Velcro.

## **International Space Station Science**

The International Space Station Microgravity studies will include scientific disciplines in fluid physics, materials science, biotechnology, combustion and others.

### **Effects of Weightlessness/Life Sciences**

- The effects of long-term exposure to reduced gravity on humans such as weakening muscles, the loss of bone density, changes in how the heart, arteries and veins work will be studied aboard the station. Studies of these effects may lead to a better understanding of the body's systems and similar ailments on Earth.
- Understanding effects and possible methods of counteracting them is needed to prepare for future long-term human exploration of the solar system.
- In addition, studies of the gravitational effects on plants and the function of living cells will be conducted aboard the station.

### **Protein Crystal Studies**

- In the microgravity of space large and nearly perfect crystals can be grown.
- Analysis of space-grown crystals helps scientists better understand the nature of proteins, enzymes and viruses, perhaps leading to the development of new drugs and a better understanding of the fundamental building blocks of life.
- This type of research could lead to the study of possible treatments for cancer, diabetes, emphysema and immune system disorders, among other research.

### **Flames, Fluids and Metal in Space**

- Fluids, flames, molten metal and other materials will be the subject of basic research on the station. Reduced gravity reduces convection currents that cause warm air or fluid to rise and cool air or fluid to sink on Earth.

### **Materials Science**

- Scientists plan to study this field to create better metal alloys and more perfect materials for applications such as computer chips. The study of all of these areas may lead to developments that can enhance many industries on Earth.

### **Exterior Experiments**

- Exterior experiments can study the space environment and how long-term exposure to space, the vacuum and the debris, affects materials. This research can provide future spacecraft designers and scientists a better understanding of the nature of space and enhance spacecraft design.

### **Fundamental Physics**

- Experiments in this field may help explain how the universe developed. This research could lead to down-to-earth developments that may include clocks a thousand times more accurate than today's atomic clocks, better weather forecasting and stronger materials.



**Watching the Earth**

- Observations of the Earth from orbit help the study of large-scale, long-term changes in the environment. Studies in this field can increase understanding of the forests, oceans and mountains.
- The effects of volcanoes, ancient meteorite impacts, hurricanes and typhoons can be studied.
- In addition, changes to the Earth that are caused by the human race can be observed.
- The effects of air pollution such as smog over cities, of deforestation, the cutting and burning of forests and water pollution such as oil spills are visible from space.

**Commercialization**

- As part of the Commercialization of space research on the station, industries will participate in research by conducting experiments and studies aimed at developing new products and services. The results may benefit those on Earth not only by providing innovative new products as a result, but also by creating new jobs to make and market the products.